Payne (S. M.)

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— DUE TO —

# Errors of Refraction.

*Read before The Ophthalmic Section of the New York Academy of Medicine, May 18th, 1893.*



BY

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II

# *INSUFFICIENCY OF THE OCULAR MUSCLES DUE TO ERRORS OF REFRACTION.*

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Mr. President and Gentlemen: This is a subject that perhaps more has been written upon, and which has been discussed more than any other in ophthalmology; but notwithstanding, I believe it is one in which the profession is more at sea than any other in the list of eye troubles. I say so because we differ so widely in our methods of treatment. Some cut the muscles, some prescribe prisms, and others correct the refraction of the eye which has the lesser error and leave the other uncorrected, or give the same glass for both eyes, when the difference of the two eyes is very great.

I have the pleasure of presenting to you tonight my investigations, and my conclusions drawn from them. I have used the word insufficiency in the title of this paper because it is the one commonly used, and not because I believe it to be the right one. I believe the only insufficiencies we have are paralysis, paresis, and permanent squint; all of which are excluded from this paper, except squint that is due to an error of refraction. I use the Stevens nomenclature because it is the true definition of the tendency of eye deviations; but I do not accept his theory, that a vertical

tendency to deviate is due to malformation of the orbit.

The main object of this paper is to show that when both eyes have the same error of refraction the tendency to deviation is either inward or outward, and that when the error of refraction is different in the two eyes there is a tendency to deviation upward or downward, and in the majority of the cases inward or outward at the same time. When both eyes are equally hypermetropic, or have the same amount of hypermetropic astigmatism, the tendency to deviation, as a rule, is inward. Where both eyes are equally myopic, or have the same amount of myopic astigmatism, the tendency to deviation, as a rule, is outward. Where the two eyes have a different degree of hypermetropia, or hypermetropic astigmatism, the tendency of the eye that has the greater error of refraction is downward and inward. Where the two eyes have a different degree of myopia, or myopic astigmatism, the tendency of the eye that has the greater error of refraction is downward and outward.

Having found as a rule that the above tendencies existed with their relative errors of refraction, the next thing was to find out the cause. I concluded that the superior and inferior recti played a part in accommodation as well as the internl and ciliary muscles. Admitting this to be the fact, for the sake of argument, we know that the inferior recti, which pull the eyes down and in, are attached nearer the cornea than the superior recti, which pull

the eyes up and in. This would give the eyes a tendency downward as well as inward in accommodation.

The eyes being emmetropic, they would show no tendency to deviation at the distance, and in looking at a point thirteen inches from the eyes, each ciliary muscle would contract so as to increase the strength of the crystalline lens to the amount of 3 D., and in the same ratio each eye would turn in and down. The same rule holds good with two eyes having the same amount of hypermetropia. That is to say, if each eye had a hypermetropia of 3 D. and had vision $\frac{20}{20}$ or $\frac{20}{15}$, each crystalline lens would be increased in strength 3 D. by the contraction of the ciliary muscles, and in consequence the interni superior and inferior recti muscles are stimulated to contract, but a counter effect of the opposing muscles keeps the eyes straight until double vision is produced by a prism, base up or down in front of one eye, which will show the tendency inward.

If we should have a hypermetropia of 3 D. in one eye, and 2 D. in the fellow eye, with vision $\frac{20}{20}$ each, we would have a tendency inward and downward of both; but as the interni, superior and inferior recti, contract in accord with the ciliary muscles, the eye which has the hypermetropia of 3 D. would turn in and down a little more because the ciliary muscle contracts to overcome the 1 D. more than its fellow eye; or the eye having the 3 D. would have a tendency to converge to a point thirteen inches from the eyes, while the one having the 2 D.

would have a tendency to converge to a point twenty inches from the eyes, and in the same ratio the eyes would have a tendency to turn downward. The same rule applies to hypermetropia with astigmatism, and hypermetropic astigmatism.

We have three reasons for a tendency to divergence, or a divergence, in myopia. The main reason is, a want of stimulus to the interni, because of the ciliary muscles not contracting in accommodation. The second is, that the optic and visual axes are nearer the same than an emmetropic or a hypermetropic eye; and in consequence has to begin farther away, and more convergence is necessary at a given point. The third is that it has to turn on its long axis.

Where the myopia of two eyes is different, the one having the greater error turns outward and downward. First, because the vision is not so good; second, to prevent double vision, as the image on the retina is larger and necessarily received by the brain as a second object. Why the eye turns down as well as out is either because the superior oblique acts with the externus against all the rest of the muscles, which are supplied by the third nerve, or because it simply swings out on a line of the position it would have if it had the power of accommodation, which would be downward and inward.

Tendency to deviate outward in hypermetropia, in the majority of cases, is found in patients who have reached the age of pres-

byopia, and sometimes in high degrees of hypermetropia. The amount is seldom more than 3°, which is due to giving up accommodation for the distance, consequently a tendency to divergence. Why some myopic eyes have a tendency to turn in, I am not able to explain, unless there is a marked difference between the optic and the visual axis, as in a hypermetropic eye.

I object to cutting the ocular muscles for tendencies to deviation. When a muscle is cut it either attaches itself back to its former place, and the same amount of tendency exists, or it is attached farther from the cornea, which is liable to produce double vision, especially if the patient looks in the direction of the cut muscle. When patients are operated upon and nothing is said to them about using their eyes, they are afraid to attempt to use them so long as there is blood under the conjunctiva, which generally lasts three or four weeks. During that time their asthenopia disappears, and they report to the surgeon that they have had no more trouble, and the surgeon thinks that the operation has made a cure. The case is then reported as cured. As soon as the patient begins to use his eyes he returns saying that his same old trouble has come back. An examination is made and the same tendency is found to exist that did exist before the operation, showing that the muscle had attached itself precisely as before. Probably another operation is performed or a number of them. If, after the final operation is performed, the

muscle is found to be attached to its former place, which is shown by the same tendency to deviation, the cure is finally effected by giving the right glasses. The patient, and probably the surgeon, thinks that the operation has had something to do with the cure. If the muscle fails to attach itself to its former place, binocular single vision is lost and may never be restored.

Those who operate for vertical tendency, cut the superior rectus, which is almost always the superior rectus of the eye that does not have the tendency to deviate, and the one that has the lesser error of refraction, which is the one the patient depends upon, instead of cutting the interior rectus of the eye that has the tendency to deviate downward.

The advantage prisms have over muscle cutting, is that you can take the prism off and leave the patient in no worse condition than when first prescribed for.

When prisms are prescribed without correcting the error of refraction, the patient will return with the same complaint; an examination will show that the eyes have the same degree of tendency to deviation with the prescribed prisms on, or twice the amount that they had in the beginning; if the prisms are increased they will still have the original tendency in addition to what was prescribed the last time. If the error of refraction is corrected and along with it prisms to correct the existing tendency to deviation, the eyes will show, when the patient returns, a less degree

than was corrected by the prism, with only the correction of the refraction before the eyes; because the tendency to deviate is corrected in part or in whole by the correction of the error of refraction.

I am confident that all tendencies to deviations and believe that all deviations, caused by errors of refraction, can be corrected by correcting the errors of refraction, ambliopic eyes included.

My method of examination and prescribing is as follows: having first examined with the ophthalmoscope, and found the total error as nearly as possible, I then begin with the test lenses. When I find that the two eyes accept the same strength plus glasses, I place them in front of both eyes at once; then the next stronger glasses before removing the first, and so on until I get the strongest before both eyes that they will accept. In this way the patient will as a rule accept very nearly the total amount of hypermetropia, and at the same time, if a tendency to deviation exists, it is wholly or partly corrected.

Where only partly corrected, a few days wearing of the glasses will entirely correct the tendency to deviate.

The majority of patients can relax the ciliary muscle much better with the use of both eyes at once.

When the patient has the same amount of hypermetropia in both eyes with the same or different degree of astigmatism, I place that combination before the eyes, and then the next

stronger sphericals behind the cylinders, and so on until I get the strongest they will accept in addition to the cylinders. In hypermetropic astigmatism I simply give what the patient accepts over each eye separately.

Where the manifest hypermetropia is different in the two eyes, it does not necessarily follow that the total is different in the two eyes. especially if the difference in the manifest is very slight. It is only in such cases with a few exceptions that I use atropine. It is these cases that show a vertical tendency to deviate, except the ones that prove to have the same hypermetropia under atropine; because, if two eyes have the same amount of hypermetropia, and a different amount of manifest with each eye separately, they will have the same amount of manifest with both eyes together. I measure the tendency to deviate with and without atropine. If the tendency amounts to so much that it is almost a squint, or occasional squint, I prescribe the total correction; but if the degree is small, I will examine the eyes after they have recovered from atropine, and instead of giving them what each eye accepts I leave the same amount of hypermetropia uncorrected in each eye, which gives each ciliary muscle the same amount of contraction to correct the uncorrected error. By this means the vertical tendency to deviate will be corrected as well as the horizontal tendency.

If the same glass is prescribed for both eyes when the refraction is different the horizontal tendency may disappear in part or entirely, but the vertical tendency will not.

I always give the total correction in all forms of myopia, and never use atropine, unless I suspect spasm of accommodation, which will be shown in the eyes requiring a much weaker glass to improve the vision, the same that is required in myopia, and a tendency of the eyes to turn in.

When the two eyes have a different degree of myopia, the image on the back of each eye is different in size, and one object is received by the brain as two objects; to avoid this, the eye which has the poorer vision and magnifies the object more, deviates, as a rule, outward and downward, or, has a tendency in that direction. This is always shown by placing a red glass before either eye. When the total correction is placed before each eye the images are brought down to the same size, and if the deviation or the tendency to deviation is not corrected immediately, it is by a few hours or a few days wearing.

Prisms might be prescribed or operations performed at intervals during the patient's lifetime, and the tendency to deviate would never be corrected until the images were made the same size.

Progressive myopia will continue to progress if you try to please your patients by giving them an under correction for reading or any near work, and full correction for the distance, or allow them to use the under correction for both far and near, unless they have reached the age of presbyopia. I believe it is the tendency to divergence that causes myopia to

progress. By giving the full correction, the eyes act as emmetropic eyes; the tendency to divergence disappears; the ciliary muscles have to contract at the near point and along with them the other muscles of accommodation.

I have had the satisfaction of examining a great many patients who have had two pairs of glasses prescribed, one for the distance and one for the near, and to the best of my recollection every one had become more near sighted, except some who said they soon found that their eyes were more comfortable with the distance glasses for all purposes, and that they had laid their near glasses aside. I have examined a number of cases after having prescribed the total correction months or years before, and never had to increase the strength of the glasses in as many as a half dozen cases.

Some will say that patients who have a high degree of myopia are not able to wear the full correction for the near. I succeed in making the patients wear the full correction for all distances, until they have reached the age of presbyopia. They see much better with a weaker glass for the near and will object to wearing the total correction unless given an intelligent reason for doing so. I tell them that as they have been seeing near objects without the use of the ciliary muscle it has become weak, that if they will be content to use the full correction the strength of the ciliary muscles will in a short time return, and that the tendency to deviation, which causes headache and pain in their eyes, will disappear

A distinguished ophthalmologist said in one of his papers that asthenopia was due to the contraction of the ciliary muscles; that a myope who did not have the use of the ciliary muscles for the near, only complained of not being able to see well. My experience is that the majority complain of pain in eyes and headaches, which shows evidently that it is caused by contraction of one or more of the external muscles of the eye, or, a tendency to deviation. Pain or headache can be caused by the contraction of one muscle of the eye as well as by another. It is simply an over exertion that makes a muscle tired, and this produces pain in eyes and headaches.

Myopic patients more commonly complain of pain and headaches at the near point. This is because the vision is better at a near point, and the two eyes conflict on account of the difference in size of the objects received. It is a common thing for patients to say that while riding in a car, looking out at various objects the car is passing, they have headaches and pain in eyes. I have found that all these patients have a tendency to eye deviation. One eye deviates more or less in passing from one object to another, just as it moves in or out when covered by a hand.

I believe in cases of permanent squint, that we should first try to straighten the eyes with glasses, whether one eye is ambliopic or not. When a muscle is cut we rarely ever get binocular single vision, but if the eyes can be straightened by glasses, binocular single vision

will be obtained. I have straightened the eyes in several cases where one eye was ambiopic. In cases of squint due to hypermetropia atropine is used, but not in myopia.

I have a collection of two hundred cases, arranged in the table following. One hundred and one have the same error of refraction. Ninety-one of these have a horizontal tendency to deviate. Ten have a vertical tendency to deviate, nine of the ten having a horizontal tendency as well. Of the ninety-nine cases having a different error of refraction of the two eyes, eighty have a vertical tendency to deviate, nineteen a horizontal tendency to deviate, and sixty-nine of the eighty cases have a horizontal tendency as well. In the eighty cases of vertical tendency, sixty have a tendency of one eye downward, and twenty of one eye upward.

These cases were taken from our case books from May 1888 to May 1890, and I noticed in a number of them that only one examination was made. Since that time, I have made my examinations with a view to proving more conclusively the rule that horizontal tendencies only, exist in eyes having the same error of refraction, and that vertical tendencies exist in eyes having a different error of refraction.

When the first examination failed to prove the rule, a second examination, especially with atropine, proved the rule to hold good, almost without exception.

The following table will show 14½ per cent of exceptions.

In the next two hundred cases, which I hope to report soon, the exceptions will I think amount to less than 5 per cent.

In this paper you have my views on the subject of muscular insufficiencies. I should be very glad to hear the result of the experience of others.

| Refraction same in both eyes. | Esophoria. | Exophoria. | Hypophoria. | Hyperphoria. | Hypoesophoria. | Hyperesophoria. | Hyperexophoria. | Hyperexophoria. | Total. | With the rule. | Against the rule. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hypermetropia | 51 | 12 | 1 | | 4 | | 1 | | 69 | 63 | 6 |
| H. with Astig | 9 | | | | 1 | | | | 10 | 9 | 1 |
| Hyperopic " | 4 | 3 | | | | | | | 7 | 7 | 0 |
| Myopia | 3 | 3 | | | | | 3 | | 9 | 5 | 2 |
| M. with Astig | 1 | 3 | | | | | | | 4 | 4 | 0 |
| Myopic " | 2 | | | | | | 1 | | 3 | 2 | 1 |
| Mixed " | 1 | | | | | | | | 1 | 1 | 0 |
| Total | 70 | 21 | 1 | | 5 | | 4 | | 101 | 91 | 10 |

| Refraction of the two eyes different. | Esophoria. | Exophoria. | Hypophoria. | Hyperphoria. | Hypoesophoria. | Hyperesophoria. | Hyperexophoria. | Hyperexophoria. | Total. | With the rule. | Against the rule. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hypermetropia | 2 | 1 | 2 | 1 | 9 | 1 | 1 | 2 | 19 | 16 | 3 |
| H. with Astig | 1 | | | | 10 | 3 | 4 | 1 | 19 | 18 | 1 |
| Hyperopic " | 3 | 2 | 2 | 1 | 5 | | 3 | 2 | 18 | 13 | 5 |
| Myopia | 3 | 1 | | | 1 | | 5 | 1 | 11 | 7 | 4 |
| M. with Astig | | 1 | 2 | | 3 | 1 | 9 | 1 | 17 | 16 | 1 |
| Myopic " | | | | 2 | 1 | | 2 | 2 | 7 | 7 | 0 |
| Mixed " | 2 | 3 | | 1 | | | 1 | 1 | 8 | 3 | 5 |
| Total | 11 | 8 | 6 | 5 | 29 | 5 | 25 | 10 | 99 | 80 | 19 |

The following cases may be of interest:

Case I.—July 23rd, 1895. Mrs W., aged forty-

four, has had headaches for twenty years, which usually begin in the morning and last for two or three days. The pain starts in back of eyes, extends over and around head to back part, down neck and back. For the past six months has had a constant ache around the eyes. She has been perfectly healthy in other respects.

R. V. = $\frac{3}{15}$; Hm. 0.75 D. )
L. V. = $\frac{20}{15}$; Hm. 0.75 D. ) ~ 0.75 D. ord.

Exophoria 3° with or without the above correction.

Binocular single vision with red glass.

Sursumduction each 3°, abduction 12°, adduction 28°.

– 0.75 D., for the distance relieves the tired feeling she has in her eyes. + 1.50 D. was ordered for the near.

I copy portions of two letters from Dr. W., husband of the patient.

Sept. 16th. My dear Doctor: I think sufficient time has elapsed since my wife and I were in your office, for a report. We went direct to the optician and were supplied with glasses. She put them on at once. Up to the present writing she has not had the ghost of a headache, has gained 15 lbs. in weight and over 1,000,000,000 lbs. in happiness.

Jan. 14th, 1891.—Dear Doctor: It affords me infinite satisfaction to be able to report that up to the present writing, nearly five months since our first visit to your office, there has been no return of those terrible headaches.

Case II.—Dec. 21st, 1889. Miss C. aged 20. For the last year her eyes hurt and burn after

using them for near work; does not think she sees well, especially at the distance; things look blurred when she looks at them long. Oph. + 1.50 D. both.

R. V. = $\frac{20}{20}$; $\frac{20}{15}$ W. + 0.75 D.

L. V. = $\frac{20}{20}$; $\frac{20}{15}$ W. + 0.75 D.

Esophoria 12°; with + 0.75 D. 5°.

Dec. 23rd.—Homeatropine 2 per cent, 6 times in eyes.

R. V. = $\frac{20}{100}$; $\frac{20}{15}$ with + 1.75 D.

L. V. = $\frac{20}{100}$; $\frac{20}{15}$ W. × 1.75 D.

Esophoria 8°.

Dec. 26th—R. V. = $\frac{20}{15}$; Hm. 1. d.
L. V. = $\frac{20}{15}$; Hm. 1. d. } 1.25 D. ord.

Esophoria 14°; W. × 1.25 D. 5°.

March 15th.—Has been wearing her glasses all the time since here. Eyes feel very comfortable when she has the glasses on.

Jan. 13th, 1891.—V. $\frac{20}{15}$ W. × 1.25 D. both, slightly clearer than × 1.50 D.

Esophoria 6°; W. × 1.25 D.

Orthophoria. Glasses give entire satisfaction.

Case III.—Miss S., aged 32. Up to twelve years ago had worn glasses, for five years. After breaking them she stopped wearing glasses. Cannot see well when reading. Has a sort of mist before her eyes, and they burn quite a good deal.

R.V.=$\frac{4}{200}$; $\frac{20}{20}$ W.—10. D. ⊂ —1.50 D. ax 150.
L. V. = $\frac{20}{80}$; $\frac{20}{20}$ W. —1.50 D. ax 1.50. } ord.

Right eye moves down and out. Reads Jaeger No. 1 with the above combination comfortably and also has with the above combination binocular single vision.

CASE IV.—Jan. 14th, 1892. This case is taken outside the list because of special interest.

Mr. M., aged 25. Has worn glasses a week, prescribed by an oculist. The glasses ordered were:

Right × 67 D. s. ⊂ 1.25 D. c. ax 90°.

Left, plain glass.

Three years ago he noticed that he saw imperfectly at a distance and had glasses prescribed by an oculist.

Ophthalmoscopic examination showed opaque nerve fibres and 2 D. ax 60 right eye.

Left, 13 D., partly astigmatic.

R. V. = $\frac{20}{70}$; $\frac{20}{20}$ × W. 1.50 D. ax 60.

L. V. = $\frac{4}{200}$; $\frac{20}{40}$ W. 9 D. ⊂ 3.50 D. ax 165.

With the above correction the light seen with the left eye is above and to the right, and both lights are the same size. This shows that the left eye turns down and out. The above glasses were ordered.

March 18th.—He now uses his glasses for both far and near. It took him some time to get used to them for the near, but they are now all right, and has no nausea, which he had all the time before wearing the above glasses. Now he has orthophoria.

R. V. = $\frac{20}{20}$ × W. —2 D. ax 60.

L. V. = $\frac{20}{50}$ × W. —9 D. ⊂ 3.50 D. ax 165 s.

Oct. 23rd.—Orthohoria with last glasses ordered.

R. V. = $\frac{20}{50}$; $\frac{20}{20}$ × W. —2.50 D. ax 60.

L. V. = $\frac{20}{50}$ W. —9 D. —4.50 D. ax 180.

At the time of the first visit the left eye showed a tendency downward 12°.

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